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Checklist of Helminths of Bats from Mexico and Central America

F. Agustín Jiménez,[1] Juan M. Caspeta-Mandujano,[2] Said B. Ramírez-Chávez,[2] Silvia E. Ramírez-Díaz,[2] Marissa G. Juárez-Urbina,[2] Jorge L. Peralta-Rodríguez,[2] and José A. Guerrero[2]

1 Department of Zoology, Southern Illinois University, Carbondale, Illinois, 62901-6501, USA
2 Universidad Autónoma del Estado de Morelos, Facultad de Ciencias Biológicas y Centro de Investigaciones Biológicas, Laboratorio de Parasitología, Avenida Universidad 1001, Colonia Chamilpa, CP 62209, Cuernavaca, Morelos, México

Corresponding author: Juan M. Caspeta-Mandujano, email caspeta@uaem.mx

Abstract

Based on original data obtained from fieldwork conducted from January 2008 to December 2015 and from previous records from published accounts, an updated checklist of helminth parasites of bats from Mexico and Central America is presented. The checklist has been organized in four ways, first as a helminth-host list in the state of Morelos, second as a helminth-host list with taxonomic and geographic distributional information, third as a bat-helminth list with references, and last, as a summary of the host-helminth association. A total of 105 records and 67 helminth taxa (26 trematodes, 4 cestodes, and 37 nematodes [33 adult and 5 larvae]) in 27 bat species from the families Emballonuridae, Molossidae, Mormoopidae, Natalidae, Phyllostomidae, and Vespertilionidae are presented for Mexico and Central America. Eight species of helminths are unique to Central America and ten species occur in both Mexico and the isthmus. From the helminths recorded in Mexico, 34 helminth species in 19 species of bats are present in the state of Morelos. The helminth diversity represents 58% of the total recorded thus far in Mexico, yet the diversity of bats intensively surveyed for parasites in the country represents roughly 14% of the diversity of chiropterans present. This evidence suggests that these intensive examinations are necessary to complete the helminthological record for bats, especially in areas of high endemism.

Keywords: helminths, trematodes, cestodes, nematodes, bats, Chiroptera, geographical distribution, Mexico

Introduction

Mexico is located in the transition between the Nearctic and Neotropical realms; it features a complex topography and almost all types of climates within its territory. As a consequence this country hosts an enormous biological diversity (Sarukhán et al., 2009). This diversity has been extensively documented for vertebrates, arthropods, and plants (Medellín, 2003; Rzedowski, 2006; Fernández et al., 2014; Trejo-Salazar et al., 2015; Santibáñez-López et al., 2016). With respect to the diversity of invertebrates other than arthropods, the study of helminths is asymmetrically represented since most studies have focused on fish-dwelling helminths (Salgado-Maldonado, 2006), followed by helminths of reptiles (Paredes-León et al., 2008). In contrast, few records document the diversity of helminths among the 545 species of mammals occurring in the Mexican territory (Ceballos and Arroyo-Cabrales, 2012). From that total, only 25 species have been extensively surveyed for helminths across the territory, with sparse records for roughly 135 species of mammals (García-Prieto et al., 2012; Guzmán-Cornejo et al., 2012; Jiménez, 2012). It is apparent that the

inventory of helminths of wild mammals is still incomplete (García-Prieto et al., 2012; García-Prieto et al., 2014). The helminth fauna of vertebrates from Central America shows a similar trend (Rodriguez-Ortíz et al., 2004).

Bats (Order Chiroptera) are one of the most successful groups of mammals, including about 1,100 recognized species worldwide, with 138 occurring in Mexico (Ceballos and Arroyo-Cabrales, 2012). Bats are reservoirs to a great number of pathogens including eukaryote, viral, and bacterial organisms that are known etiological agents of disease (Ubelaker et al., 1979; Hayman et al., 2013; Mühldorfer, 2013). The distribution of these parasites and pathogens in bats and their patterns of association are poorly understood (Presley et al., 2015), even when their effects on populations of chiropterans are considered good indicators of stress (Cottontail et al., 2009).

In Mexico, parasitological studies in the Order Chiroptera began in the late 1930s with the report and description of parasites of four species of bats from caves in Yucatan (Chitwood, 1938; Stunkard, 1938). These early records documented the presence of metazoans infecting the Jamaican fruit-eating bat, *Artibeus jamaicensis* Leach, 1821; the Pallas' long-tongued bat, *Glossophaga soricina* (Pallas, 1766); the little small-eared bat, *Micronycteris microtis* Miller, 1898; and the Mexican funnel-eared bat, *Natalus stramineus* Gray 1838 (*N. mexicanus*). The species of helminths recorded include the nematodes *Litomosoides* sp. (= *Litomosoides chitwoodi* Bain et al., 2003), *Bidigiticauda vivipara* Chitwood, 1938, and *Cheiropteronema globocephala* Chitwood, 1938 in the Jamaican fruit-eating bat; *Litomosoides hamletti* Chitwood, 1938 in the Pallas' long-tongued bat *Capillaria* sp. and *Anenterotrema auritum* Stunkard, 1938 (nematode and trematode, respectively) in the little small-eared bat; and the trematodes *Anenterotrema singulare* Stunkard, 1938 and *Parabascus yucatanense* Chitwood, 1938 (= *Parabascoides yucatanensis*) and the nematodes *Tricholeiperia carnegiensis* Chitwood, 1938, *T. pearsei* Chitwood, 1938, and *Seuratum cancellatum* Chitwood, 1943 occurring in the Mexican funnel-eared bat.

Scope

Studies on helminth parasites from bats were continued by Caballero (1939; 1940a,b; 1942a,b; 1943a,b,c), Caballero and Zerecero (1951), García (1995); Pérez-Ponce de León et al. (1996), Guzmán-Cornejo et al. (2003), Falcón-Ordaz et al. (2006), Clarke (2008), Eslava (2005), Peralta-Rodríguez et al. (2012), Caspeta-Mandujano et al. (2013, 2015), and Jiménez et al. (2014). Since 2008 the team of the Laboratorio de Parasitología of the Universidad Autónoma del Estado de Morelos has monitored helminths from bats in the State of Morelos (Martínez, 2009; Peralta, 2009, 2012; Tapia, 2011; Ojeda, 2013; Galindo, 2014; Juárez, 2015; Ramírez, 2015; Ramírez, 2015 and Juárez, pers. comm.). That research was supported by a compilation of records on members of the Nematoda, Cestoda, and Digenea occurring in bats and published until mid 2016, and included the sparse records generated from studies carried out in Central America. In the present manuscript we present a checklist of bat-dwelling helminths occurring in Mexico and Central America, and emphasize the diversity of helminths recorded in a small territory in central Mexico. The number of new species descriptions generated by this survey suggests that more intensive sampling across Mexico and Central America will asssist in discovering new species and characterizing their host and geographic distribution.

Materials and Methods

Using published records and unpublished information obtained from the fieldwork from 2008 to 2015, from 8 localities in the State of Morelos (Table 1; Figure 1), a checklist of the helminth parasites of bats in Mexico was generated. Helminth species are presented in taxonomical order arranged by phylum and then by family, followed by information of their host(s), state of the country of the record(s), site of infection, and reference(s).

A total of 18 bat species belonging to 6 families from 8 localities in the State of Morelos were examined for the presence of helminth parasites from January 2008 to December 2014 (Table 1). The collection of bat hosts was developed in different localities, covering the regions North, Center and South of the state; interestingly, these regions include Nearctic landscapes (i.e., pine and oak forest 2,000 m in elevation) and Neotropical dry forests. Bats were captured under *Licencia de Colector Científico* FAUT–0211 (National Collecting Permit 0211) from the *Secretaria del Medio Ambiente y Recursos Naturales* (SEMARNAT) using mist nets placed near and at the entrances of roosts, such as mines, abandoned houses, occupied vegetation, and over water bodies. Nets were set between 18:00 and 22:00 hours, with the aim of capturing at least 10 individuals per species. Bats were removed from the mist net and placed in individual canvas bags for transport to the laboratory, where they were kept alive until their helminthological examination. This examination did not exceed 24 hr upon capture. Bats were killed following standard recommendations set forth by the American Society of Mammalogists (Sikes et al., 2011). The external surface, viscera, and musculature of each individual bat were examined under a stereomicroscope, and all the helminths encountered were counted (Gardner and Jiménez-Ruiz, 2009). Trematodes, cestodes, and nematodes were fixed in hot neutral 4% formalin. Trematodes and cestodes were used for morphological studies as whole mounts; therefore, the specimens were stained with Mayer`s paracarmine, dehydrated using a graded alcohol series, cleared in methyl salicylate, and mounted in Canada balsam. Nematodes were cleared with glycerine for microscopic examination and stored in 70% ethanol.

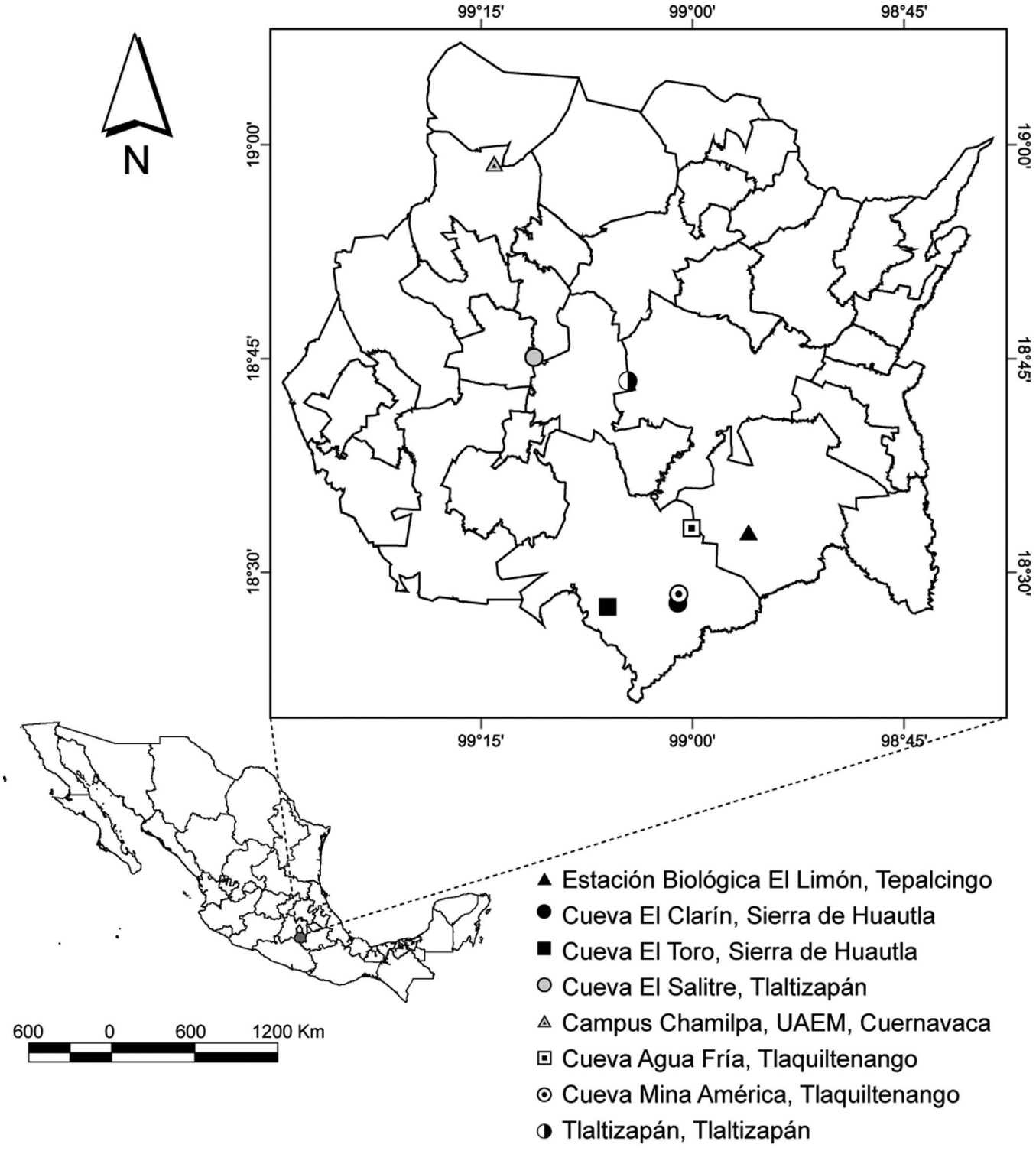

Figure 1. Eight fieldwork localities in the State of Morelos for helminth parasites of bats.

Table 1. List of records of helminth species from bats in Central Mexico from 2008 to 2015, their host(s), locality records in the State of Morelos, site of infection, and references

Helminth	Host(s)	Locality in the State of Morelos	Site of Infection	References
Phylum PLATYHELMINTHES				
Class TREMATODA				
Anchitrematidae				
Anchitrema sanguineum	*Myotis velifer*	Cueva El Salitre, Xochitepec	Intestine	Ramírez, 2015
Anenterotrematidae				
Anenterotrema auritum	*Leptonycteris yerbabuenae*	Cueva Mina América, Tlaquiltenango	Intestine	Juárez, in process
	Mormoops megalophylla	Cueva Mina América, Tlaquiltenango	Intestine	Ramírez, 2015
Dicrocoeliidae				
Dicrocoelium rileyi	*Tadarida brasiliensis*	Campus UAEM, Chamilpa	Gall-bladder	Martínez, 2009
	Tadarida brasiliensis	Campus UAEM, Chamilpa	Gall-bladder	Peralta, 2012
Lecithodendriidae				
Ochoterenatrema labda	*Tadarida brasiliensis*	Campus Chamilpa, Cuernavaca	Intestine	Martínez, 2009
	Balantiopteryx plicata	Mina América, Tlaquiltenango	Intestine	Tapia, 2011
	Balantiopteryx plicata	Estación Biológica El Limón, Tepalcingo	Intestine	Tapia, 2011
	Balantiopteryx plicata	Cueva La Presa, Quilamula, Tlaquiltenango	Intestine	Tapia, 2011
	Balantiopteryx plicata	Mina América, Tlaquiltenango	Intestine	Ojeda, 2013
	Balantiopteryx plicata	Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Balantiopteryx plicata	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Balantiopteryx plicata	Municipio de Tlaltizapán	Intestine	Peralta, 2012
	Balantiopteryx plicata	Cueva La Presa, Quilamula, Tlaquiltenango	Intestine	Peralta, 2012
	Myotis velifer	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2012
	Myotis velifer	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Myotis velifer	Cueva Agua Fría, Tlaquiltenango	Intestine	Peralta, 2012
	Mormoops megalophylla	Cueva Mina América, Tlaquiltenango	Stomach	Peralta, 2012
	Mormoops megalophylla	Cueva El Clarin, Huautla	Stomach	Peralta, 2012
	Mormoops megalophylla	Cueva El Salitre, Xochitepec	Stomach	Peralta, 2012
	Mormoops megalophylla	Cueva Mina América, Tlaquiltenango	Intestine	Ramírez, 2015
	Myotis velifer	Cueva El Salitre, Xochitepec	Intestine	Ramírez, 2015
	Tadarida brasiliensis	Campus Chamilpa, Cuernavaca	Intestine	Peralta, 2012
Paralecithodendrium scabrum	*Myotis velifer*	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2012
	Myotis velifer	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Myotis velifer	Cueva Agua Fría, Tlaquiltenango	Intestine	Peralta, 2012
	Mormoops megalophylla	Cueva Mina América, Tlaquiltenango	Intestine	Ramírez, 2015
Phaneropsolidae				
Limatulum diminutum	*Pteronotus parnellii*	Cueva Mina América, Tlaquiltenango	Stomach	Peralta, 2009
	Mormoops megalophylla	Cueva Mina América, Tlaquiltenango	Stomach	Ramírez, 2015
	Pteronotus parnellii	Estación Biológica El Limón, Tepalcingo	Stomach	Peralta, 2012
	Pteronotus parnellii	Cueva Mina América, Tlaquiltenango	Stomach	Peralta, 2012

Table 1. (continued) Records of helminth species from bats in Central Mexico from 2008 to 2015

Helminth	Host(s)	Locality in the State of Morelos	Site of Infection	References
	Pteronotus parnellii	Cueva El Salitre, Xochitepec	Stomach	Peralta, 2012
	Pteronotus parnellii	Cueva La Presa, Quilamula, Tlaquiltenango	Stomach	Peralta, 2012
	Pteronotus personatus	Cueva Mina América, Tlaquiltenango	Stomach	Peralta, 2012
	Pteronotus davyi	Cueva Mina América, Tlaquiltenango	Stomach	Peralta, 2012
	Pteronotus davyi	Cueva Mina América, Tlaquiltenango	Stomach	Juárez, 2015
Limatulum gastroides	*Pteronotus davyi*	Cueva Mina América, Tlaquiltenango	Stomach	Peralta, 2012
	Balantiopteryx plicata	Cueva Mina América, Tlaquiltenango	Stomach	Ojeda, 2013
	Balantiopteryx plicata	Mina América, Tlaquiltenango	Stomach	Peralta, 2012
	Balantiopteryx plicata	Estación Biológica El Limón, Tepalcingo	Stomach	Peralta, 2012
	Balantiopteryx plicata	Municipio de Tlaltizapán	Stomach	Peralta, 2012
	Balantiopteryx plicata	Cueva La Presa, Quilamula, Tlaquiltenango	Stomach	Peralta, 2012
	Pteronotus davyi	Cueva Mina América, Tlaquiltenango	Stomach	Juárez, 2015
	Mormoops megalophylla	Cueva Mina América, Tlaquiltenango	Stomach	Peralta, 2012
	Mormoops megalophylla	Cueva El Clarin, Huautla	Stomach	Peralta, 2012
	Mormoops megalophylla	Cueva El Salitre, Xochitepec	Stomach	Peralta, 2012
	Pteronotus parnellii	Estación Biológica El Limón, Tepalcingo	Stomach	Peralta, 2012
	Pteronotus parnellii	Cueva Mina América, Tlaquiltenango	Stomach	Peralta, 2012
	Pteronotus parnellii	Cueva El Salitre, Xochitepec	Stomach	Peralta, 2012
	Pteronotus parnellii	Cueva La Presa, Quilamula, Tlaquiltenango	Stomach	Peralta, 2012
Limatulum limatulum	*Tadarida brasiliensis*	Campus UAEM, Chamilpa	Stomach	Martínez, 2012
	Pteronotus parnellii	Cueva El Salitre, Xochitepec	Stomach	Peralta, 2009
	Myotis velifer	Cueva El Salitre, Xochitepec	Stomach	Ramírez, 2015
	Myotis velifer	Cueva El Salitre, Xochitepec	Stomach	Peralta, 2012
	Myotis velifer	Estación Biológica El Limón, Tepalcingo	Stomach	Peralta, 2012
	Myotis velifer	Cueva Agua Fría, Tlaquiltenango	Stomach	Peralta, 2012
	Pteronotus davyi	Mina América, Tlaquiltenango	Stomach	Juárez, 2015
	Mormoops megalophylla	Mina América, Tlaquiltenango	Stomach	Ramírez, 2015
	Pteronotus parnellii	Estación Biológica El Limón, Tepalcingo	Stomach	Peralta, 2012
	Pteronotus parnellii	Cueva Mina América, Tlaquiltenango	Stomach	Peralta, 2012
	Pteronotus parnellii	Cueva El Salitre, Xochitepec	Stomach	Peralta, 2012
	Pteronotus parnellii	Cueva La Presa, Quilamula, Tlaquiltenango	Stomach	Peralta, 2012
Limatulum oklahomense	*Pteronotus parnellii*	Cueva El Salitre Xochitepec	Stomach	Peralta, 2009
	Pteronotus parnellii	Estación Biológica El Limón, Tepalcingo	Stomach	Peralta, 2012
	Pteronotus parnellii	Cueva Mina América, Tlaquiltenango	Stomach	Peralta, 2012
	Pteronotus parnellii	Cueva El Salitre, Xochitepec	Stomach	Peralta, 2012
	Pteronotus parnellii	Cueva La Presa, Quilamula, Tlaquiltenango	Stomach	Peralta, 2012
	Natalus stramineus	Estación Biológica El Limón, Tepalcingo	Stomach	Peralta, 2012
	Natalus stramineus	Cueva El Clarin, Huautla	Stomach	Peralta, 2012
	Natalus stramineus	Cueva El Toro, Huautla	Stomach	Peralta, 2012
	Pteronotus davyi	Cueva Mina América, Tlaquiltenango	Stomach	Juárez, 2015
	Mormoops megalophylla	Cueva Mina América, Tlaquiltenango	Stomach	Ramírez, 2015

Table 1. (continued) Records of helminth species from bats in Central Mexico from 2008 to 2015

Helminth	Host(s)	Locality in the State of Morelos	Site of Infection	References
Parabascus yucatanensis	*Mormoops megalophylla*	Cueva Mina América, Tlaquiltenango	Intestine	Ramírez, 2015
	Mormoops megalophylla	Cueva Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Mormoops megalophylla	Cueva El Clarin, Huautla	Intestine	Peralta, 2012
	Mormoops megalophylla	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2012
	Natalus stramineus	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Natalus stramineus	Cueva El Clarin, Huautla	Intestine	Peralta, 2012
	Natalus stramineus	Cueva El Toro, Huautla	Intestine	Peralta, 2012
Tremajoannes buckleyi	*Myotis velifer*	Cueva El Salitre, Xochitepec	Intestine	Ramírez, 2015
Plagiorchiidae				
Plagiorchis muris	*Pteronotus parnellii*	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2009
	Pteronotus parnellii	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Pteronotus parnellii	Cueva Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Pteronotus parnellii	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2012
	Pteronotus parnellii	Cueva La Presa, Quilamula, Tlaquiltenango	Intestine	Peralta, 2012
Plagiorchis vespertilionis	*Myotis velifer*	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Myotis velifer	Cueva Agua Fría, Quilamula, Tlaquiltenango	Intestine	Peralta, 2012
	Myotis velifer	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2012
Urotrematidae				
Urotrema scabridum	*Tadarida brasiliensis*	Campus UAEM, Chamilpa	Intestine	Martínez, 2009
	Tadarida brasiliensis	Campus UAEM, Chamilpa	Intestine	Peralta, 2012
	Pteronotus parnellii	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2009
	Balantiopteryx plicata	Mina América, Tlaquiltenango	Intestine	Ojeda, 2013
	Pteronotus davyi	Cueva Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Pteronotus davyi	Mina América, Tlaquiltenango	Intestine	Juárez, 2015
	Pteronotus personatus	Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Myotis velifer	Cueva El Salitre, Xochitepec	Intestine	Ramírez, 2015
	Mormoops megalophylla	Mina América, Tlaquiltenango	Intestine	Ramírez, 2015
	Pteronotus parnellii	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Pteronotus parnellii	Cueva Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Pteronotus parnellii	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2012
	Pteronotus parnellii	Cueva La Presa, Quilamula, Tlaquiltenango	Intestine	Peralta, 2012
	Balantiopteryx plicata	Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Balantiopteryx plicata	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Balantiopteryx plicata	Municipio de Tlaltizapán	Intestine	Peralta, 2012
	Balantiopteryx plicata	Cueva La Presa, Quilamula, Tlaquiltenango	Intestine	Peralta, 2012

Table 1. (continued) Records of helminth species from bats in Central Mexico from 2008 to 2015

Helminth	Host(s)	Locality in the State of Morelos	Site of Infection	References
Class CESTODA				
Hymenolepididae				
Vampirolepis decipiens	*Tadarida brasiliensis*	Campus UAEM, Chamilpa	Intestine	Martínez, 2009
	Tadarida brasiliensis	Campus UAEM, Chamilpa	Intestine	Peralta, 2012
	Pteronotus parnellii	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2009
	Balantiopteryx plicata	Cueva La Presa, Quilamula, Tlaquiltenango	Intestine	Tapia, 2011
	Balantiopteryx plicata	Mina América, Tlaquiltenango	Intestine	Tapia, 2011
	Balantiopteryx plicata	Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Balantiopteryx plicata	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Balantiopteryx plicata	Municipio de Tlaltizapán	Intestine	Peralta, 2012
	Balantiopteryx plicata	Cueva La Presa, Quilamula, Tlaquiltenango	Intestine	Peralta, 2012
	Balantiopteryx plicata	Cueva Mina América, Tlaquiltenango	Intestine	Ojeda, 2013
	Mormoops megalophylla	Cueva Mina América, Tlaquiltenango	Intestine	Ramírez, 2015
	Mormoops megalophylla	Cueva Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Mormoops megalophylla	Cueva El Clarin, Huautla	Intestine	Peralta, 2012
	Mormoops megalophylla	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2012
	Myotis velifer	Cueva El Salitre, Xochitepec	Intestine	Ramírez, 2015
	Myotis velifer	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2012
	Myotis velifer	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Myotis velifer	Cueva Agua Fría, Tlaquiltenango	Intestine	Peralta, 2012
	Natalus stramineus	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Natalus stramineus	Cueva El Clarin, Huautla	Intestine	Peralta, 2012
	Natalus stramineus	Cueva El Toro, Huautla	Intestine	Peralta, 2012
	Pteronotus parnellii	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Pteronotus parnellii	Cueva Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Pteronotus parnellii	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2012
	Pteronotus parnellii	Cueva La Presa, Quilamula, Tlaquiltenango	Intestine	Peralta, 2012
Vampirolepis elongatus	*Balantiopteryx plicata*	Cueva La Presa, Quilamula, Tlaquiltenango	Intestine	Tapia, 2011
	Balantiopteryx plicata	Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Balantiopteryx plicata	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Balantiopteryx plicata	Municipio de Tlaltizapán	Intestine	Peralta, 2012
	Balantiopteryx plicata	Cueva La Presa, Quilamula, Tlaquiltenango	Intestine	Peralta, 2012
	Dermanura azteca	Campus UAEM, Chamilpa	Intestine	Peralta, 2012
	Leptonycteris yerbabuenae	Cueva Mina América, Tlaquiltenango	Intestine	Juárez, in process
	Leptonycteris yerbabuenae	Cueva Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Leptonycteris yerbabuenae	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Leptonycteris yerbabuenae	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2012
	Mormoops megalophylla	Cueva Mina América, Tlaquiltenango	Intestine	Ramírez, 2015
	Glossophaga soricina	Cueva Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Glossophaga soricina	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Glossophaga soricina	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2012

Table 1. (continued) Records of helminth species from bats in Central Mexico from 2008 to 2015

Helminth	Host(s)	Locality in the State of Morelos	Site of Infection	References
Vampirolepis gertschi	*Macrotus waterhousii*	Cueva Mina América, Tlaquiltenango	Intestine	Galindo, 2014
	Mormoops megalophylla	Cueva Mina América, Tlaquiltenango	Intestine	Ramírez, 2015
	Pteronotus parnellii	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Pteronotus parnellii	Cueva Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Pteronotus parnellii	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2012
	Pteronotus parnellii	Cueva La Presa, Quilamula, Tlaquiltenango	Intestine	Peralta, 2012
	Macrotus waterhousii	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Macrotus waterhousii	Cueva Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Macrotus waterhousii	Campus UAEM, Chamilpa	Intestine	Peralta, 2012
Phylum NEMATODA				
Superfamily TRICHOSTRONGYLOIDEA				
Ornithostrongylidae				
Allintoshius tadaridae	*Myotis velifer*	Cueva El Salitre, Xochitepec	Intestine	Ramírez, 2015
	Myotis velifer	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2012
	Myotis velifer	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Myotis velifer	Cueva Agua Fría, Tlaquiltenango	Intestine	Peralta, 2012
	Mormoops megalophylla	Cueva Mina América, Tlaquiltenango	Intestine	Ramírez, 2015
Molineidae				
Biacantha desmoda	*Desmodus rotundus*	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2012
	Desmodus rotundus	Cueva Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Desmodus rotundus	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Desmodus rotundus	Cueva Agua Fría, Tlaquiltenango	Intestine	Peralta, 2012
Linustrongylus pteronoti	*Pteronotus davyi*	Cueva Mina América, Tlaquiltenango	Intestine	Juárez, 2015
Macuahuitloides inexpectans	*Mormoops megalophylla*	Cueva Mina América, Tlaquiltenango	Intestine	Jiménez et al., 2014; Ramírez, 2015
Tadaridanema delicatus	*Tadarida brasiliensis*	Campus UAEM, Chamilpa	Intestine	Martínez, 2009
	Tadarida brasiliensis	Campus UAEM, Chamilpa	Intestine	Peralta, 2012
Torrestrongylus tetradorsalis	*Macrotus waterhousii*	Mina América, Tlaquiltenango	Intestine	Caspeta-Mandujano et al., 2015
	Macrotus waterhousii	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Macrotus waterhousii	Cueva Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Macrotus waterhousii	Campus UAEM, Chamilpa	Intestine	Peralta, 2012
Tricholeiperia carnegiensis	*Natalus stramineus*	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Natalus stramineus	Cueva El Clarin, Huautla	Intestine	Peralta, 2012
	Natalus stramineus	Cueva El Toro, Huautla	Intestine	Peralta, 2012
	Mormoops megalophylla	Cueva Mina América, Tlaquiltenango	Intestine	Ramírez, 2015
	Mormoops megalophylla	Cueva Mina América, Tlaquiltenango	Stomach	Peralta, 2012
	Mormoops megalophylla	Cueva El Clarin, Huautla	Stomach	Peralta, 2012
	Mormoops megalophylla	Cueva El Salitre, Xochitepec	Stomach	Peralta, 2012

Table 1. (continued) Records of helminth species from bats in Central Mexico from 2008 to 2015

Helminth	Host(s)	Locality in the State of Morelos	Site of Infection	References
Websternema parnelli	*Pteronotus parnellii*	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2009
	Pteronotus parnellii	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Pteronotus parnellii	Cueva Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Pteronotus parnellii	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2012
	Pteronotus parnellii	Cueva La Presa, Quilamula, Tlaquiltenango	Intestine	Peralta, 2012
Superfamily TRICHINELLOIDEA				
Capillariidae				
Aonchotheca speciosa	*Tadarida brasiliensis*	Campus UAEM, Chamilpa	Stomach	Peralta, 2012
	Glossophaga soricina	Cueva Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Glossophaga soricina	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Glossophaga soricina	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2012
	Leptonycteris yerbabuenae	Cueva Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Leptonycteris yerbabuenae	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Leptonycteris yerbabuenae	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2012
	Leptonycteris yerbabuenae	Cueva Mina América, Tlaquiltenango	Stomach	Juárez, in process
	Macrotus waterhousii	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Macrotus waterhousii	Cueva Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Macrotus waterhousii	Campus UAEM, Chamilpa	Intestine	Peralta, 2012
	Dermanura azteca	Campus UAEM, Chamilpa	Intestine	Peralta, 2012
	Myotis velifer	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2012
	Myotis velifer	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Myotis velifer	Cueva Agua Fría, Tlaquiltenango	Intestine	Peralta, 2012
	Natalus stramineus	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Natalus stramineus	Cueva El Clarin, Huautla	Intestine	Peralta, 2012
	Natalus stramineus	Cueva El Toro, Huautla	Intestine	Peralta, 2012
	Mormoops megalophylla	Cueva Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Mormoops megalophylla	Cueva El Clarin, Huautla	Intestine	Peralta, 2012
	Mormoops megalophylla	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2012
Capillaria palmata	*Tadarida brasiliensis*	Campus UAEM, Chamilpa	Stomach	Martínez, 2009
Capillaria sp.	*Desmodus rotundus*	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2012
	Desmodus rotundus	Cueva Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Desmodus rotundus	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Desmodus rotundus	Cueva Agua Fría, Tlaquiltenango	Intestine	Peralta, 2012
Pterothominx sp.	*Pteronotus davyi*	Cueva Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Pteronotus davyi	Cueva Mina América, Tlaquiltenango	Intestine	Juárez, 2015
	Pteronotus parnellii	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2009
	Pteronotus parnellii	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Pteronotus parnellii	Cueva Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Pteronotus parnellii	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2012
	Pteronotus parnellii	Cueva La Presa, Quilamula, Tlaquiltenango	Intestine	Peralta, 2012
	Mormoops megalophylla	Cueva Mina América, Tlaquiltenango	Intestine	Ramírez, 2015

Table 1. (continued) Records of helminth species from bats in Central Mexico from 2008 to 2015

Helminth	Host(s)	Locality in the State of Morelos	Site of Infection	References
Trichuroides myoti	*Balantiopteryx plicata*	Mina América, Tlaquiltenango	Stomach	Peralta, 2012
	Balantiopteryx plicata	Estación Biológica El Limón, Tepalcingo	Stomach	Peralta, 2012
	Balantiopteryx plicata	Municipio de Tlaltizapán	Stomach	Peralta, 2012
	Balantiopteryx plicata	Cueva La Presa, Quilamula, Tlaquiltenango	Stomach	Peralta, 2012
	Myotis velifer	Cueva El Salitre, Xochitepec	Stomach	Ramirez, 2015
Superfamily FILARIOIDEA				
Onchocercidae				
Litomosoides guiterasi	*Pteronotus parnellii*	Cueva El Salitre, Xochitepec	Mesentery	Peralta, 2009
	Pteronotus parnellii	Estación Biológica El Limón, Tepalcingo	Mesentery	Peralta, 2012
	Pteronotus parnellii	Cueva Mina América, Tlaquiltenango	Mesentery	Peralta, 2012
	Pteronotus parnellii	Cueva El Salitre, Xochitepec	Mesentery	Peralta, 2012
	Pteronotus parnellii	Cueva La Presa, Quilamula, Tlaquiltenango	Mesentery	Peralta, 2012
	Leptonycteris yerbabuenae	Cueva Mina América, Tlaquiltenango	Mesentery	Peralta, 2012
	Leptonycteris yerbabuenae	Cueva El Salitre, Xochitepec	Mesentery	Peralta, 2012
	Leptonycteris yerbabuenae	Estación Biológica El Limón, Tepalcingo	Mesentery	Peralta, 2012
	Glossophaga soricina	Cueva Mina América, Tlaquiltenango	Mesentery	Peralta, 2012
	Glossophaga soricina	Estación Biológica El Limón, Tepalcingo	Mesentery	Peralta, 2012
	Glossophaga soricina	Cueva El Salitre, Xochitepec	Mesentery	Peralta, 2012
	Macrotus waterhousii	Cueva Mina América, Tlaquiltenango	Mesentery	Galindo, 2014
	Mormoops megalophylla	Cueva Mina América, Tlaquiltenango	Mesentery	Ramírez, 2015
Litomosoides guiterasi (as a larva)	*Pteronotus parnellii*	Cueva El Salitre, Xochitepec	Mesentery	Peralta, 2012
	Leptonycteris yerbabuenae	Estación Biológica El Limón, Tepalcingo	Mesentery	Peralta, 2012
Superfamily PHYSALOPTEROIDEA				
Physalopteridae				
Physaloptera sp. (as a larva)	*Mormoops megalophylla*	Cueva Mina América, Tlaquiltenango	Mesentery	Ramírez, 2015
Spiruridae				
Spirura mexicana	*Pteronotus parnellii*	Cueva El Salitre, Xochitepec	Esophagus	Peralta, 2009
	Pteronotus parnellii	Cueva El Salitre, Xochitepec	Esophagus	Peralta et al., 2012
	Pteronotus parnellii	Estación Biológica El Limón, Tepalcingo	Esophagus	Peralta, 2012
	Pteronotus parnellii	Cueva Mina América, Tlaquiltenango	Esophagus	Peralta, 2012
	Pteronotus parnellii	Cueva El Salitre, Xochitepec	Esophagus	Peralta, 2012
	Pteronotus parnellii	Cueva La Presa, Quilamula, Tlaquiltenango	Esophagus	Peralta, 2012
	Pteronotus personatus	Mina América, Tlaquiltenango	Esophagus	Peralta, 2012
	Pteronotus davyi	Cueva Mina América, Tlaquiltenango	Esophagus	Peralta, 2012
	Pteronotus davyi	Cueva Mina América, Tlaquiltenango	Esophagus	Juárez, 2015
	Mormoops megalophylla	Cueva Mina América, Tlaquiltenango	Esophagus	Ramírez, 2015
	Macrotus waterhousii	Cueva Mina América, Tlaquiltenango	Esophagus	Galindo, 2014
	Macrotus waterhousii	Estación Biológica El Limón, Tepalcingo	Esophagus	Peralta, 2012
	Macrotus waterhousii	Cueva Mina América, Tlaquiltenango	Esophagus	Peralta, 2012
	Macrotus waterhousii	Campus UAEM, Chamilpa	Esophagus	Peralta, 2012

Table 1. (continued) Records of helminth species from bats in Central Mexico from 2008 to 2015

Helminth	Host(s)	Locality in the State of Morelos	Site of Infection	References
Spirocercidae				
Physocephalus sexalatus (as a larva)	*Pteronotus parnellii*	Cueva El Salitre, Xochitepec	Mesentery	Peralta, 2009
	Pteronotus parnellii	Estación Biológica El Limón, Tepalcingo	Mesentery	Peralta, 2012
	Pteronotus parnellii	Cueva Mina América, Tlaquiltenango	Mesentery	Peralta, 2012
	Pteronotus parnellii	Cueva El Salitre, Xochitepec	Mesentery	Peralta, 2012
	Pteronotus parnellii	Cueva La Presa, Quilamula, Tlaquiltenango	Mesentery	Peralta, 2012
	Balantiopteryx plicata	Estación Biológica El Limón, Tepalcingo	Mesentery	Tapia, 2011
	Balantiopteryx plicata	Cueva La Presa, Quilamula, Tlaquiltenango	Mesentery	Tapia, 2011
	Balantiopteryx plicata	Mina América, Tlaquiltenango	Mesentery and intestine	Tapia, 2011
	Balantiopteryx plicata	Mina América, Tlaquiltenango	Mesentery	Peralta, 2012
	Balantiopteryx plicata	Estación Biológica El Limón, Tepalcingo	Mesentery	Peralta, 2012
	Balantiopteryx plicata	Municipio de Tlaltizapán	Mesentery	Peralta, 2012
	Balantiopteryx plicata	Cueva La Presa, Quilamula, Tlaquiltenango	Mesentery	Peralta, 2012
	Balantiopteryx plicata	Cueva Mina América, Tlaquiltenango	Mesentery	Ojeda, 2013
	Micronycteris microtis (as *Micronycteris megalotis*)	Cueva Mina América, Tlaquiltenango	Mesentery	Peralta, 2012
	Micronycteris microtis (as *Micronycteris megalotis*)	Cueva La Presa, Quilamula, Tlaquiltenango	Mesentery	Peralta, 2012
	Micronycteris microtis (as *Micronycteris megalotis*)	Estación Biológica El Limón, Tepalcingo	Mesentery	Peralta, 2012
	Pteronotus davyi	Cueva Mina América, Tlaquiltenango	Mesentery	Juárez, 2015
	Glossophaga soricina	Cueva Mina América, Tlaquiltenango	Mesentery	Peralta, 2012
	Glossophaga soricina	Estación Biológica El Limón, Tepalcingo	Mesentery	Peralta, 2012
	Glossophaga soricina	Cueva El Salitre, Xochitepec	Mesentery	Peralta, 2012
Superfamily RICTULARIOIDEA				
Rictaluriidae				
Pterygodermatites (*Pterygodermatites*) *mexicana*	*Balantiopteryx plicata*	Cueva La Presa, Quilamula, Tlaquiltenango	Intestine	Caspeta-Mandujano et al., 2013
	Balantiopteryx plicata	Cueva La Presa, Quilamula, Tlaquiltenango	Intestine	Tapia, 2011
	Balantiopteryx plicata	Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Balantiopteryx plicata	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Balantiopteryx plicata	Municipio de Tlaltizapán	Intestine	Peralta, 2012
	Balantiopteryx plicata	Cueva La Presa, Quilamula, Tlaquiltenango	Intestine	Peralta, 2012
	Balantiopteryx plicata	Cueva Mina América, Tlaquiltenango	Intestine	Ojeda, 2013

Table 1. (continued) Records of helminth species from bats in Central Mexico from 2008 to 2015

Helminth	Host(s)	Locality in the State of Morelos	Site of Infection	References
Acuariidae gen. sp. (as a larva)	*Tadarida brasiliensis*	Campus UAEM, Chamilpa	Stomach	Martínez, 2009
	Tadarida brasiliensis	Campus UAEM, Chamilpa	Stomach	Peralta, 2012
	Pteronotus parnellii	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2009
	Balantiopteryx plicata	Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Balantiopteryx plicata	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Balantiopteryx plicata	Municipio de Tlaltizapán	Intestine	Peralta, 2012
	Balantiopteryx plicata	Cueva La Presa, Quilamula, Tlaquiltenango	Intestine	Peralta, 2012
	Balantiopteryx plicata	Cueva Mina América, Tlaquiltenango	Intestine	Ojeda, 2013
	Mormoops megalophylla	Cueva Mina América, Tlaquiltenango	Intestine	Ramírez, 2015
	Mormoops megalophylla	Cueva Mina América, Tlaquiltenango	Stomach	Peralta, 2012
	Mormoops megalophylla	Cueva El Clarin, Huautla	Stomach	Peralta, 2012
	Mormoops megalophylla	Cueva El Salitre, Xochitepec	Stomach	Peralta, 2012
	Myotis velifer	Cueva El Salitre, Xochitepec	Intestine	Ramírez, 2015
	Pteronotus parnellii	Estación Biológica El Limón, Tepalcingo	Intestine	Peralta, 2012
	Pteronotus parnellii	Cueva Mina América, Tlaquiltenango	Intestine	Peralta, 2012
	Pteronotus parnellii	Cueva El Salitre, Xochitepec	Intestine	Peralta, 2012
	Pteronotus parnellii	Cueva La Presa, Quilamula, Tlaquiltenango	Intestine	Peralta, 2012
Nematoda gen. sp. (as a larva)	*Balantiopteryx plicata*	Mina América, Tlaquiltenango	Liver	Ojeda, 2013
	Mormoops megalophylla	Mina América, Tlaquiltenango	Intestine	Ramírez, 2015
	Tadarida brasiliensis	Campus UAEM, Chamilpa	Intestine	Martínez, 2009
	Pteronotus parnellii	Cueva El Salitre, Xochitepec	Liver	Peralta, 2009
	Pteronotus parnellii	Estación Biológica El Limón, Tepalcingo	Liver	Peralta, 2012
	Pteronotus parnellii	Cueva Mina América, Tlaquiltenango	Liver	Peralta, 2012
	Pteronotus parnellii	Cueva El Salitre, Xochitepec	Liver	Peralta, 2012
	Pteronotus parnellii	Cueva La Presa, Quilamula, Tlaquiltenango	Liver	Peralta, 2012
	Pteronotus davyi	Cueva Mina América, Tlaquiltenango	Liver	Peralta, 2012
	Dermanura azteca	Campus UAEM, Chamilpa	Liver	Peralta, 2012
	Leptonycteris yerbabuenae	Cueva Mina América, Tlaquiltenango	Liver	Peralta, 2012
	Leptonycteris yerbabuenae	Cueva El Salitre, Xochitepec	Liver	Peralta, 2012
	Leptonycteris yerbabuenae	Estación Biológica El Limón, Tepalcingo	Liver	Peralta, 2012
	Balantiopteryx plicata	Mina América, Tlaquiltenango	Mesentery	Peralta, 2012
	Balantiopteryx plicata	Estación Biológica El Limón, Tepalcingo	Mesentery	Peralta, 2012
	Balantiopteryx plicata	Municipio de Tlaltizapán	Mesentery	Peralta, 2012
	Balantiopteryx plicata	Cueva La Presa, Quilamula, Tlaquiltenango	Mesentery	Peralta, 2012

Voucher specimens of each helminth species were deposited in the Colección Nacional de Helmintos (CNHE), Instituto de Biología, Universidad Nacional Autónoma de México. Names for all bat species have been standardized using current nomenclature (Wilson and Reeder, 2005; Ceballos and Arroyo-Cabrales, 2012). However, information available in some published accounts did not allow this because in some cases there was no voucher specimen for the host and/or several congeneric species occur in sympatry, which makes identification impossible based on nonstandard common names. The taxonomy of helminths follows the criteria used in previous checklists of Neotropical bats (Santos and Gibson, 2015).

Results

Composition of the helminthological record

The helminthological record in bats in Mexico includes 59% of taxa included in Nematoda and 41% of Platyhelminthes. The mayority of the species assigned to Platyhelminthes (85%) belongs to the class Trematoda, whereas the remaining 15% belongs to Cestoda (Table 1).

Helminth – bat records

Table 2 offers a reconstruction of the host spectrum of each species of helminth. It is worth noting that several of the species of bats are known exclusively from one host and one locality, usually reported in their original description. This is the case for *Rictularia nana* Caballero, 1943; *Bidigiticauda vivipara* Chitwood, 1938; *Pterygodermatites mexicana* Caspeta-Mandujano et al., 2013; and *Tricholeiperia pearsei* Chitwood, 1938.

Helminths recorded per species of bat

The information presented in Table 3 acts as a helminthological record per each species of bat. From the 27 species of bats included, *M. megalophylla* shows the greatest number of records (23 taxa). The helminthological record for *Trachops cirrhosus*, *Lasiurus cinereus*, and *L. blossevillii* in Mexico includes a single species. In Table 4 we present those records that could not be confirmed given the lack of voucher specimens or a precise identification of the species of bat. Finally, in Table 5 we present a relationship of the bat-helminth association.

Discussion

The helminthological record for bats in Mexico includes 49 taxa, 68 including available records for Central America. This number is relatively low given a high expectation of species diversity resulting from the high diversity and abundance of bats in this megadiverse region. This apparent low diversity may be an artifact of sampling, since several of the species of parasites are known from a single record (Chandler, 1938; Chitwood, 1938; Stunakrd, 1938). In Mexico and Central America, there are very few studies that include a comprehensive survey of the helminthological fauna in a diverse group of bats, following a geographical or taxonomical approach (Ubelaker et al., 1979; Vaucher and Durette-Desset, 1986; Guzmán-Cornejo et al., 2003; Clarke, 2008). The value of surveys examining several species of bats in a single locality is threefold in that it increases the chances in detecting rare species of parasites, allows identifying patterns of host specificity (see Table 5), and facilitates the determination of a range of distribution for each species of parasite. The latter is an important aspect because species of parasites may feature a more restricted geographic distribution than their hosts.

Finally, our results highlight the relevance of methodic localized-intensive surveys to both characterize the host range of metazoan parasites and increase the chance of detecting rare or uncommon species. This information is crucial to assess the actual biodiversity of a region. With an area of 4,950 km^2, Morelos is slightly larger than the state of Rhode Island (3,672 km^2), yet the results of our parasitological examinations resulted in 34 species of helminths (Table 1). This number represents 58% of the species of helminths recorded in Mexico. In addition, the diversity of helminths in Morelos includes 4 species that were described by our team (Peralta-Rodríguez et al., 2012; Caspeta-Mandujano et al., 2013, 2015; Jiménez et al., 2014), which represents 8% of the diversity of helminths reported in chiropterans in Mexico. In comparison, the total number of bat species surveyed for helminths in Mexico includes 19 species, which roughly represents 14% of the total diversity of chiropterans present in this country. Using a simple linear relationship, one may expect that the helminthological examination of the remaining 121 species of bats will result in the description of at least 25 new species, yet this number must be greater assuming that there are species of bats which have never been surveyed for parasites, including members of the families Noctilionidae and Thyropteridae, which have very specialized diets and morphology.

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Table 2. Records of helminth species from bats in Mexico and Central America, their host(s), geographical records, site of infection, and bibliographic references
BR = Brazil, CO = Colombia, CR = Costa Rica, MX = Mexico, NI = Nicaragua, PA = Panama, VE = Venezuela

Helminth	Host(s)	State/Province, Country	Site of Infection	References
Phylum PLATYHELMINTHES				
Class TREMATODA				
Anchitrematidae				
Anchitrema sanguineum	*Myotis velifer*	Morelos, MX	Intestine	Ramírez, 2015
Anenterotrematidae				
Anenterotrema auritum	*Micronycteris microtis* (as *M. megalotis mexicana*)	Yucatán, MX	Intestine	Stunkard, 1938; Ubelaker et al., 1979; Lunaschi and Drago, 2011
	Natalus mexicanus	Yucatán, MX	Intestine	Stunkard, 1938; García-Prieto et al., 2012
	Leptonycteris yerbabuenae	Morelos, MX	Intestine	Juárez, in process
	Mormoops megalophylla	Morelos, MX	Intestine	Ramírez, 2015
	Pteronotus parnellii	Hidalgo, MX	Intestine	Caballero y Zerecero, 1942; García et al., 2012
	Pteronotus personatus	Veracruz, MX	Intestine	Clarke, 2008
	Mormoops megalophylla	Veracruz, MX	Intestine	Clarke, 2008
Anenterotrema stunkardi	*Phyllostomus hastatus*	Chilibrillo, PN	Intestine	Caballero and Groccott, 1960; Lamothe-Argumedo et al., 1997
Anenterotrema freitasi	*Micronycteris hirsuta*	Alajuela, CR	Intestine	Caballero, 1964
Dicrocoeliidae				
Dicrocoelium rileyi	*Tadarida brasiliensis*	Morelos, MX	Gallbladder	Martínez, 2009; Peralta, 2012
	Tadarida brasiliensis	Durango, MX	Gallbladder	Guzmán-Cornejo et al., 2003; García-Prieto et al., 2012
	Tadarida brasiliensis	Puebla, MX	Gallbladder	Guzmán-Cornejo et al., 2003; Caballero and Caballero, 1969
	Tadarida brasiliensis	Nuevo León, MX	Gallbladder	Guzmán-Cornejo et al., 2003; Díaz-Moreno, 1977; Caballero y Caballero & Caballero-Rodríguez, 1969; García-Prieto et al., 2012
	Tadarida brasiliensis	Zacatecas, MX	Gallbladder	Guzmán-Cornejo et al., 2003; García-Prieto et al., 2012
Platynosum beltrani	*Tadarida brasiliensis*	Nuevo León, MX	Intestine	Caballero y Caballero & Caballero-Rodríguez, 1969
Lecithodendriidae				
Castroia silvai	*Micronycteris hirsuta*	Alajuela, CR	Intestine	Caballero and Montero-Gei, 1963; Lamothe-Argumedo et al., 1997; Rodríguez-Ortíz et al., 2004
Ochoterenatrema labda	*Mormoops megalophylla*	Morelos, MX	Intestine, stomach	Peralta, 2012; Ramírez, 2015
	Mormoops megalophylla	Veracruz, MX	Intestine	Clarke, 2008
	Pteronotus davyi	Veracruz, MX	Intestine	Clarke, 2008
	Natalus stramineus	Mexico City, MX	Intestine	Caballero y Caballero, 1943a
	Balantiopteryx plicata	Morelos, MX	Intestine	Ojeda, 2013; Tapia, 2011; Peralta, 2012
	Myotis velifer	Morelos, MX	Intestine	Ramírez, 2015; Peralta, 2012
	Natalus mexicanus	Mexico City, MX; Estado de México, MX	Intestine	Lamothe-Argumedo et al., 1997
	Tadarida brasiliensis	Morelos, MX	Intestine	Martínez, 2009; Peralta, 2012
	Tadarida brasiliensis	Mexico City, MX	Intestine	Caballero y Caballero 1943a; García-Prieto et al., 2012
	Tadarida brasiliensis	Durango, MX	Intestine	Guzmán-Cornejo et al., 2003; García-Prieto et al., 2012
	Tadarida brasiliensis	Estado de México, MX	Intestine	Caballero y Caballero, 1943a; García-Prieto et al., 2012
	Tadarida brasiliensis	Nuevo León, MX	Intestine	Guzmán-Cornejo et al., 2003; Díaz-Moreno, 1977; García-Prieto et al., 2012
	Tadarida brasiliensis	Puebla, MX	Intestine	Guzmán-Cornejo et al., 2003; García-Prieto et al., 2012
	Tadarida brasiliensis	Zacatecas, MX	Intestine	Guzmán-Cornejo et al., 2003; García-Prieto et al., 2012

Table 2 (continued). Records of helminth species from bats in Mexico and Central America,

Helminth	Host(s)	State/Province, Country	Site of Infection	References
Paralecithodendrium emodillum	*Natalus mexicanus*	Mexico City, MX	Intestine	Caballero and Caballero, 1943a; Pérez-Ponce et al., 1996; Lamothe-Argumedo et al., 1997; García-Prieto et al., 2012
Paralecithodendrium macnabi	*Lasiurus cinereus*	Mexico City, MX	Intestine	Caballero and Caballero y Zerecero, 1951; Lamothe-Argumedo et al., 1997; García-Prieto et al., 2012
Paralecithodendrium scabrum	*Lasiurus cinereus*	Mexico City, MX	Intestine	Caballero, 1943b; Caballero and Zerecero, 1951
	Myotis velifer	Morelos, MX	Intestine	Peralta, 2012
	Mormoops megalophylla	Morelos, MX	Intestine	Ramírez, 2015
Prosthodendrium cordiforme	*Eptesicus propinquus*	Finca Monte de Heredia, CR	Intestine	Caballero and Brenes-Madrigal, 1957; Lamothe-Argumedo et al., 1997; Rodríguez-Ortíz et al., 2004
Phaneropsolidae				
Limatulum aberrans	*Macrotus waterhousii* (as *Macrotus mexicanus mexicanus*)	Oaxaca, MX	Intestine	Caballero and Bravo, 1950; Ubelaker et al., 1979; Pérez-Ponce de León et al., 1996; Lamothe-Argumedo et al., 1997; García-Prieto et al., 2012
Limatulum costarricensis	*Eptesicus propinquus*	Finca Monte de Heredia, CR	Intestine	Caballero and Brenes-Madrigal, 1957; Lamothe-Argumedo et al., 1997; Rodríguez-Ortíz et al., 2004
Limatulum diminutum	*Pteronotus parnellii*	Morelos, MX	Stomach	Peralta, 2009, 2012
	Pteronotus davyi	Morelos, MX	Stomach	Peralta, 2012; Juárez, 2015
	Pteronotus personatus	Morelos, MX	Stomach	Peralta, 2012
	Mormoops megalophylla	Morelos, MX	Stomach	Ramírez, 2015
Limatulum gastroides	*Pteronotus parnellii*	Morelos, MX	Stomach	Peralta, 2012
	Pteronotus parnellii	Jalisco, MX	Intestine	Garcia-Vargas et al., 1996; Pérez-Ponce de León et al., 1996; García-Prieto et al., 2012
	Balantiopteryx plicata	Morelos, MX	Stomach	Ojeda, 2013; Peralta, 2012
	Mormoops megalophylla	Morelos, MX	Stomach	Peralta, 2012
	Pteronotus davyi	Morelos, MX	Stomach	Peralta, 2012; Juárez, 2015
Limatulum isthmicus	*Micronycteris hirsuta*	Heredia, CR	Intestine	Caballero, 1964
Limatulum limatulum	*Natalus mexicanus*	Hidalgo, MX	Intestine	Caballero, 1943b
		Oaxaca, MX	Intestine	Caballero and Bravo, 1950
	Tadarida brasiliensis	Morelos, MX	Stomach	Martínez, 2009
	Pteronotus parnellii	Morelos, MX	Stomach	Peralta, 2009, 2012
	Myotis velifer	Morelos, MX	Stomach	Ramírez, 2015; Peralta, 2012
	Pteronotus davyi	Morelos, MX	Stomach	Juárez, 2015
	Mormoops megalophylla	Morelos, MX	Stomach	Ramírez, 2015
Limatulum oklahomense	*Pteronotus parnellii*	Morelos, MX	Stomach	Peralta, 2009, 2012
	Natalus mexicanus	Hidalgo, MX	Stomach	Caballero, 1943a; Caballero and Bravo, 1950; Lamothe-Argumedo et al., 1997
	Natalus stramineus	Morelos, MX	Stomach	Peralta, 2012
	Pteronotus davyi	Morelos, MX	Stomach	Juárez, 2015
	Mormoops megalophylla	Morelos, MX	Stomach	Ramírez, 2015
	Myotis nigricans	Panama, PN	Intestine	Ubelaker et al., 1979
Maxbraunium tubiporum	*Micronycteris hirsuta*	Heredia, CR	Intestine	Caballero, 1964
	Mormoops megalophylla	Veracruz, MX	Intestine	Clarke, 2008
	Pteronotus personatus	Veracruz, MX	Intestine	Clarke, 2008
	Pteronotus parnellii	Hidalgo, MX	Intestine	Caballero and Zerecero, 1942; Pérez-Ponce et al., 1996; García-Prieto et al., 2012

Table 2 (continued). Records of helminth species from bats in Mexico and Central America,

Helminth	Host(s)	State/Province, Country	Site of Infection	References
Parabascus yucatanensis	*Natalus mexicanus*	Yucatán, MX	Intestine	Stunkard, 1938; García-Prieto et al., 2012
	Natalus mexicanus	Morelos, MX	Intestine	Peralta, 2012
	Mormoops megalophylla	Morelos, MX	Intestine	Peralta, 2012; Ramírez, 2015
Tremajoannes buckleyi	*Myotis velifer*	Morelos, MX	Intestine	Ramírez, 2015
Plagiorchiidae				
Plagiorchis micracanthos	*Pipistrellus hesperus*	Sinaloa, MX	Intestine	Heddergott y Steinbach, 2015
Plagiorchis muris	*Natalus mexicanus*	Mexico City, MX	Intestine	Caballero, 1943; Pérez-Ponce et al., 1996; Lamothe-Argumedo *et al.,* 1997; García-Prieto et al., 2012
	Natalus mexicanus	Estado de México, MX	Intestine	Caballero, 1943
	Pteronotus parnellii	Morelos, MX	Intestine	Peralta, 2009, 2012
Plagiorchis vespertilionis	*Tadarida brasiliensis*	Mexico City, MX	Intestine	Caballero, 1940, 1943a; Lamothe-Argumedo et al., 1997; García-Prieto et al., 2012
	Myotis velifer	Morelos, MX	Intestine	Peralta, 2012
Urotrematidae				
Urotrema scabridum	*Tadarida brasiliensis*	Morelos, MX	Intestine	Martínez, 2009; Peralta, 2012
	Pteronotus parnellii	Morelos, MX	Intestine	Peralta, 2009, 2012
	Pteronotus parnellii	Morelos, MX	Intestine	Peralta, 2009, 2012
	Balantiopteryx plicata	Morelos, MX	Intestine	Ojeda, 2013; Peralta, 2012
	Pteronotus davyi	Morelos, MX	Intestine	Juárez, 2015; Peralta, 2012
	Pteronotus personatus	Morelos, MX	Intestine	Peralta, 2012
	Myotis velifer	Morelos, MX	Intestine	Ramírez, 2015
	Mormoops megalophylla	Morelos, MX	Intestine	Ramírez, 2015
	Tadarida brasiliensis	Durango, MX	Intestine	Guzmán-Cornejo et al., 2003
	Tadarida brasiliensis	Estado de México, MX	Intestine	Caballero, 1942
	Tadarida brasiliensis	Nuevo León, MX	Intestine	Guzmán-Cornejo et al., 2003; Díaz-Moreno, 1977
	Tadarida brasiliensis	Puebla, MX	Intestine	Guzmán-Cornejo et al., 2003
	Natalus mexicanus	Mexico City, MX	Intestine	Caballero, 1942a; Lamothe-Argumedo et al., 1997; García-Prieto et al., 2012
	Eptesicus propinquus	Finca Monte de Heredia, CR	Intestine	Caballero et al., 1957; Lamothe-Argumedo et al., 1997; Rodríguez-Ortíz et al., 2004
Class CESTODA				
Hymenolepididae				
Vampirolepis artibei	*Artibeus phaeotis*	Veracruz, MX	Intestine	García, 1986; Lamothe-Argumedo et al., 1997; García-Prieto et al., 2012
Vampirolepis decipiens	*Tadarida brasiliensis*	Morelos, MX	Intestine	Martínez, 2009; Peralta, 2012
	Pteronotus parnellii	Morelos, MX	Intestine	Peralta, 2009, 2012
	Balantiopteryx plicata	Morelos, MX	Intestine	Tapia, 2011; Peralta, 2012; Ojeda, 2013
	Mormoops megalophylla	Morelos, MX	Intestine	Peralta, 2012; Ramírez, 2015
	Natalus mexicanus	Morelos, MX	Intestine	Peralta, 2012
	Myotis velifer	Morelos, MX	Intestine	Peralta, 2012; Ramírez, 2015
Vampirolepis elongatus	*Pteronotus davyi*	Jalisco, MX	Intestine	García-Vargas et al., 1996
	Artibeus jamaicensis	Jalisco, MX	Intestine	García-Vargas et al., 1996
	Pteronotus davyi	Veracruz, MX	Intestine	Clarke, 2008
	Mormoops megalophylla	Veracruz, MX	Intestine	Clarke, 2008

Table 2 (continued). Records of helminth species from bats in Mexico and Central America,

Helminth	Host(s)	State/Province, Country	Site of Infection	References
	Balantiopteryx plicata	Morelos, MX	Intestine	Tapia, 2011; Peralta, 2012
	Dermanura azteca	Morelos, MX	Intestine	Peralta, 2012
	Leptonycteris yerbabuenae	Morelos, MX	Intestine	Juárez, in process; Peralta, 2012
	Mormoops megalophylla	Morelos, MX	Intestine	Ramírez, 2015
	Glossophaga soricina	Morelos, MX	Intestine	Peralta, 2012
	Glossophaga soricina	Nicaragua, NI	Intestine	Ubelaker et al., 1979
	Artibeus jamaicensis	Veracruz, MX	Intestine	García, 1995; Lamothe-Argumedo et al., 1997; García-Prieto et al., 2012
	Molossus ater	Río de Janeiro, BR	Intestine	Ubelaker et al., 1979
Vampirolepis gertschi	*Macrotus waterhousii*	Morelos, MX	Intestine	Peralta, 2012; Galindo, 2014
	Mormoops megalophylla	Morelos, MX	Intestine	Ramírez, 2015
	Pteronotus parnellii	Morelos, MX	Intestine	Peralta, 2012
Phylum NEMATODA				
Superfamily TRICHOSTRONGYLOIDEA				
Ornithostrongylidae				
Allintoshius tadaridae	*Myotis velifer*	Morelos, MX	Intestine	Ramírez, 2015; Peralta, 2012
	Mormoops megalophylla	Morelos, MX	Intestine	Ramírez, 2015
	Tadarida brasiliensis	Mexico City, MX	Intestine	Caballero, 1942
	Tadarida brasiliensis	Estado de México, MX	Intestine	Caballero, 1942
	Natalus mexicanus	Estado de México, MX	Intestine	Caballero, 1942
	Natalus mexicanus	Mexico City, MX	Intestine	Caballero, 1942; Lamothe-Argumedo et al., 1997; García-Prieto et al., 2012
Molineidae				
Biacantha desmoda	*Desmodus rotundus*	Jalisco, MX	Intestine	García et al., 1996; Pérez-Ponce et al., 1996; García-Prieto et al., 2012
		Morelos, MX	Intestine	Peralta 2012
		Zacatecas, MX	Intestine	Wolfgang, 1956
		Nayarit, MX	Intestine	Wolfgang, 1956
		Veracruz, MX	Intestine	Wolfgang, 1956
		La Pacífica, CR	Intestine	Wolfgang, 1956; Ubelaker et al., 1979
Bidigiticauda vivipara	*Artibeus jamaicensis*	Yucatán, MX	Intestine	Chitwood, 1938; Pérez-Ponce de León et al., 1996; Lamothe-Argumedo et al., 1997; García-Prieto et al., 2012
		Guerrero, MX	Intestine	Caballero-Deloya, 1971; Pérez-Ponce de León et al., 1996; Lamothe-Argumedo et al., 1997; García-Prieto et al., 2012
		La Pacífica, CR	Intestine	Ubelaker et al., 1979
		Sabana Grande, NI	Intestine	Ubelaker et al., 1979
	Artibeus lituratus	Guerrero, MX	Intestine	Caballero-Deloya, 1971; Chitwood, 1938
	Artibeus lituratus	Chiapas, MX	Intestine	Ubelaker et al., 1979
Cheiropteronema globocephala	*Artibeus jamaicensis*	Yucatán, MX	Intestine	Chitwood, 1938; Sandground, 1929; Ubelaker et al., 1979; García-Prieto et al., 2012
		Osa Peninsula, CR	Intestine	Ubelaker et al., 1979
	Artibeus lituratus	Chiapas, MX	Intestine	Ubelaker et al., 1979
		Sabana Grande, NI	Intestine	Ubelaker et al., 1979
	Artibeus phaeotis	Osa Peninsula, CR	Intestine	Ubelaker et al., 1979
		Chiapas, MX	Intestine	Ubelaker et al., 1979
		San Antonio, NI	Intestine	Ubelaker et al., 1979

Table 2 (continued). Records of helminth species from bats in Mexico and Central America,

Helminth	Host(s)	State/Province, Country	Site of Infection	References
	Artibeus toltecus	Chiapas, MX	Intestine	Ubelaker et al., 1979
	Carollia perspicillata	Osa Península, CR	Intestine	Ubelaker et al., 1979
	Carollia perspicillata	E Moyogalpa, NI	Intestine	Ubelaker et al., 1979
Histiostrongylus coronatus	*Phyllostomus discolor*	Chiapas, MX	Intestine	Ubelaker et al., 1979
		Mato Grosso, BR	Intestine	Ubelaker et al., 1979
		Sabana Grande, NI	Intestine	Ubelaker et al., 1979
	Phyllostomus hastatus	Sabana Grande, NI	Intestine	Ubelaker et al., 1979
Histiostrongylus spinosus	*Phyllostomus discolor*	Nicaragua	Intestine	Vaucher and Durette-Desset, 1999
Linustrongylus pteronoti	*Glossophaga soricina*	Jalisco, MX	Intestine	García, 1995; Pérez-Ponce et al., 1996; Lamothe-Argumedo et al., 1997; García-Prieto et al., 2012
	Pteronotus parnellii	Veracruz, MX		Clarke, 2008
	Pteronotus davyi	Morelos, MX	Intestine	Juárez, 2015
	Mormoops megalophylla	Nicaragua		Vaucher and Durette-Desset, 1986
Macuahuitloides inexpectans	*Mormoops megalophylla*	Morelos, MX	Intestine	Jiménez et al., 2014; Ramírez, 2015
Parahistiostrongylus octacanthus	*Artibeus jamaicensis*	Nicaragua	Intestine	Ubelaker et al., 1979
	Phyllostomus hastatus	Nicaragua	Intestine	Ubelaker et al., 1979
Tadaridanema delicatus	*Tadarida brasiliensis*	Nuevo León, MX	Intestine	Falcón-Ordaz, et al., 2006; Guzmán-Cornejo et al., 2003; García-Prieto et al., 2012
	Tadarida brasiliensis	Durango, MX	Intestine	Falcón-Ordaz, et al., 2006; Guzmán-Cornejo et al., 2003; García-Prieto et al., 2012
	Tadarida brasiliensis	Zacatecas, MX	Intestine	Falcón-Ordaz, et al., 2006; Guzmán-Cornejo et al., 2003; García-Prieto et al., 2012
	Tadarida brasiliensis	Sinaloa, MX	Intestine	Cain y Studier, 1974
	Tadarida brasiliensis	Puebla, MX	Intestine	Falcón-Ordaz, et al., 2006; Guzmán-Cornejo et al., 2003; García-Prieto et al., 2012
		Morelos, MX	Intestine	Martínez, 2009; Peralta, 2012
Torrestrongylus tetradorsalis	*Macrotus waterhousii*	Morelos, MX	Intestine	Caspeta-Mandujano et al., 2015; Peralta, 2012
Tricholeiperia carnegiensis	*Natalus mexicanus*	Yucatán, MX	Intestine	Chitwood, 1938; Pérez-Ponce et al., 1996; Lamothe-Argumedo et al., 1997; García-Prieto et al., 2012
	Natalus mexicanus	Morelos	Intestine	Peralta, 2012
	Mormoops megalophylla	Morelos, MX	Intestine	Peralta, 2012; Ramírez, 2015
Tricholeiperia leiperi	*Trachops cirrhosus*	Chiapas, MX	Intestine	Caballero, 1951; Ubelaker et al., 1979; Pérez-Ponce et al., 1996; Lamothe-Argumedo et al., 1997; García-Prieto et al., 2012
Tricholeiperia pearsei	*Natalus mexicanus*	Yucatán, MX	Lung	Chitwood, 1938; Pérez-Ponce et al., 1996; García-Prieto et al., 2012
Websternema parnelli	*Pteronotus parnellii*	Jalisco, MX	Intestine	García, 1995; Pérez-Ponce et al., 1996; Lamothe-Argumedo et al., 1997; García-Prieto et al., 2012
		Nicaragua	Intestine	Vaucher and Durette-Desset, 1986
	Pteronotus parnellii	Morelos, MX	Intestine	Peralta, 2009, 2012
Superfamily TRICHINELLOIDEA				
Capillariidae				
Aonchotheca martinezi	*Natalus mexicanus* (as *Natalus stramineus*)	Mexico City, MX	Stomach	Caballero, 1942b; Moravec, 1982; Pérez-Ponce de León et al., 1996; Lamothe-Argumedo et al., 1997; García-Prieto et al., 2012
Aonchotheca speciosa	*Natalus mexicanus*	Morelos, MX	Intestine	Peralta, 2012
	Glossophaga soricina	Morelos, MX	Intestine	Peralta, 2012
	Leptonycteris yerbabuenae	Morelos, MX	Intestine	Juárez, in process; Peralta, 2012

Table 2 (continued). Records of helminth species from bats in Mexico and Central America,

Helminth	Host(s)	State/Province, Country	Site of Infection	References
	Macrotus waterhousii	Morelos, MX	Intestine	Peralta, 2012
	Dermanura azteca	Morelos, MX	Intestine	Peralta, 2012
	Myotis velifer	Morelos, MX	Intestine	Peralta, 2012
	Mormoops megalophylla	Morelos, MX	Intestine	Peralta, 2012
	Dermanura azteca	Morelos, MX	Intestine	Peralta, 2012
	Tadarida brasiliensis	Morelos, MX	Intestine	Peralta, 2012
Capillaria palmata	*Tadarida brasiliensis*	Morelos, MX	Intestine	Martínez, 2009
Capillaria sp.	*Desmodus rotundus*	Yucatán, MX	Intestine, stomach	Lamothe-Argumedo et al., 1997; Rojas and Guerrero, 2007
	Micronycteris microtis	Yucatán, MX	Intestine	Chitwood, 1938
	Pteronotus davyi	*Pteronotus personatus*	Veracruz	Intestine Clarke, 2008
	Desmodus rotundus	Morelos, MX	Intestine	Peralta, 2012
Pterothominx sp.	*Pteronotus parnellii*	Jalisco, MX	Intestine	García, 1996; Lamothe-Argumedo et al., 1997; García-Prieto et al., 2012
	Pteronotus davyi	Morelos, MX	Intestine	Peralta, 2012
	Pteronotus davyi	Morelos, MX	Intestine	Juárez, 2015
	Pteronotus parnellii	Morelos, MX	Intestine	Peralta, 2009, 2012
	Mormoops megalophylla	Morelos, MX	Intestine	Ramírez, 2015
Trichuroides myoti	*Balantiopteryx plicata*	Morelos, MX	Stomach	Peralta, 2012
	Myotis velifer	Morelos, MX	Stomach	Ramirez, 2015
Superfamily FILARIOIDEA				
Onchocercidae				
Litomosoides brasiliensis	Artibeus toltecus	Veracruz, MX	Mesentery	Lamothe-Argumedo et al., 1993; Pérez-Ponce de León et al., 1996; García-Prieto et al., 2012; Bain et al, 2003
	Carollia perspicillata	Costa Rica	Mesentery	Caballero, 1944; Jiménez-Quiroz & Arrollo, 1960
		Panama	Mesentery	Caballero & Caballero, 1944; Ubelaker et al., 1979
Litomosoides chitwoodi	*Artibeus jamaicensis*	Yucatán, MX	Mesentery	Bain et al., 2003; García-Prieto et al., 2012
Litomosoides fosteri	*Glossophaga soricina*	Panama	Mesentery	Caballero, 1947; Ubelaker et al., 1979; Lamothe-Argumedo et al., 1997
Litomosoides guiterasi	*Pteronotus parnellii*	Chiapas, MX	Mesentery	Ubelaker et al., 1979
	Pteronotus parnellii	Morelos, MX	Mesentery	Peralta, 2009, 2012
	Glossophaga soricina	Morelos, MX	Mesentery	Peralta, 2012
	Leptonycteris yerbabuenae	Morelos, MX	Mesentery	Peralta, 2012
	Macrotus waterhosii	Morelos, MX	Mesentery	Galindo, 2014
	Mormoops megalophylla	Morelos, MX	Mesentery	Ramírez, 2015
Litomosoides sp. (as a larva)	*Pteronotus parnellii*	Morelos, MX	Mesentery	Peralta, 2012
	Leptonycteris yerbabuenae	Morelos, MX	Intestine	Peralta, 2012
Litomosoides hamletti	*Glossophaga soricina*	Yucatán, MX	Mesentery	Chitwood, 1938; Pérez-Ponce de León et al., 1996; García-Prieto et al., 2012
Litomosoides leonilavazquezae	*Macrotus waterhousii mexicanus* (as *M. mexicanus mexicanus*)	Guerrero, MX	Mesentery	Caballero, 1939; Ubelaker et al., 1979; Pérez-Ponce de León et al., 1996; Lamothe-Argumedo et al., 1997; García-Prieto et al., 2012
Litomosoides penai	*Carollia perspicillata*	Costa Rica	Mesentery	Jiménez-Quirós and Arroyo-Sancho, 1960
Litomosoides sp. (microfilariae)	*Artibeus jamaicensis*	Panama	Blood	Bain et al, 2002
		Costa Rica	Blood	Cottontail et al., 2009

Table 2 (continued). Records of helminth species from bats in Mexico and Central America,

Helminth	Host(s)	State/Province, Country	Site of Infection	References
Superfamily PHYSALOPTEROIDEA				
Physalopteridae				
Physaloptera sp. (as a larva)	*Mormoops megalophylla*	Morelos, MX	Mesentery	Ramírez, 2015
Spiruridae				
Spirura mexicana	*Pteronotus parnellii*	Morelos, MX	Esophagus	Peralta, 2009; Peralta et al., 2012
	P. personatus	Morelos, MX	Esophagus	Peralta, 2012
	P. davyi	Morelos, MX	Esophagus	Peralta, 2012; Juárez, 2015
	Mormoops megalophylla	Morelos, MX	Esophagus	Ramírez, 2015
	Macrotus waterhousii	Morelos, MX	Esophagus	Galindo, 2014; Peralta, 2012
Spirocercidae				
Physocephalus sexalatus (as a larva)	*Pteronotus parnellii*	Morelos, MX	Mesentery	Peralta, 2009, 2012
	Balantiopteryx plicata	Morelos, MX	Mesentery	Tapia, 2011; Peralta, 2012; Ojeda, 2013
	Micronycteris microtis (as *M. megalotis*)	Morelos, MX	Mesentery	Peralta, 2012
	Pteronotus davyi	Morelos, MX	Mesentery	Juárez, 2015
	Glossophaga soricina	Morelos, MX	Mesentery	Peralta, 2012
Superfamily RICTULARIOIDEA				
Rictaluriidae				
Pterygodermatites (*Pterygodermatites*) *mexicana*	*Balantiopteryx plicata*	Morelos, MX	Intestine	Caspeta-Mandujano et al., 2013; Tapia, 2011; Peralta, 2012; Ojeda, 2013
Rictularia nana	*Balantiopteryx plicata*	Puebla, MX	Intestine	Caballero, 1943c; García-Prieto et al., 2012; Pérez-Ponce de León et al., 1996
Seuratidae				
Seuratum cancellatum	*Natalus mexicanus*	Yucatán, MX	Lungs	Chitwood, 1938; García-Prieto et al., 2012; Pérez-Ponce de León et al., 1996
Acuariidae gen. sp. (as a larva)	*Tadarida brasiliensis*	Morelos, MX	Stomach	Martínez, 2009; Peralta, 2012
	Pteronotus parnellii	Morelos, MX	Intestine	Peralta, 2009, 2012
	Balantiopteryx plicata	Morelos, MX	Intestine	Peralta, 2012; Ojeda, 2013
	Mormoops megalophylla	Morelos, MX	Stomach, intestine	Peralta, 2012; Ramírez, 2015
	Myotis velifer	Morelos, MX	Intestine	Ramírez, 2015
Nematoda gen. sp. (as a larva)	*Balantiopteryx plicata*	Morelos, MX	Liver	Ojeda, 2013
	Mormoops megalophylla	Morelos, MX	Intestine	Ramírez, 2015
	Tadarida brasiliensis	Morelos, MX	Intestine	Martínez, 2009
	Pteronotus parnellii	Morelos, MX	Liver	Peralta, 2009, 2012
	P. davyi	Morelos, MX	Liver	Peralta, 2012
	D. azteca	Morelos, MX	Liver	Peralta, 2012
	Leptonycteris yerbabuenae	Morelos, MX	Liver	Peralta, 2012
	Balantiopteryx plicata	Morelos, MX	Liver	Peralta, 2012

Table 3. Checklist of species of parasites recorded per bat species in Mexico and Central America

Bat Species	Helminth Species	References
Family Emballonuridae		
Balantiopteryx plicata Peters, 1867	*Ochoterenatrema labda*	Caballero, 1943
	Limatulum gastroides	García, 1995
	Urotrema scabridum	Caballero y Caballero 1942a
	Vampirolepis decipiens	Peralta, 2009
	Vampirolepis elongatus	García, 1995
	Trichuroides myoti	Peralta, 2012
	Physocephalus sexalatus (as a larva)	Peralta, 2012
	Pterygodermatites (*Pterygodermatites*) *mexicana*	Caspeta-Mandujano et al. 2013
	Rictularia nana	Caballero, 1943c
	Acuariidae gen. sp. (as a larva)	Peralta, 2012
	Nematoda gen. sp. (as a larva)	Peralta, 2012
Family Molossidae		
Tadarida brasiliensis (Geoffroy, 1824)	*Dicrocoelium rileyi*	Caballero and Caballero, 1969
	Platynosum beltrani	Caballero and Caballero, 1969
	Ochoterenatrema labda	Caballero, 1943
	Limatulum limatulum	Caballero, 1943b
	Plagiorchis vespertilionis	Caballero, 1940
	Urotrema scabridum	Caballero, 1942
	Vampirolepis decipiens	Peralta, 2012
	Allintoshius tadaridae	Caballero, 1942
	Tadaridanema delicatus	Falcon-Ordaz et al., 2006
	Capillaria palmata	Martínez, 2009
	Acuariidae gen. sp. (as a larva)	Martínez, 2009
	Nematoda gen. sp. (as a larva)	Martínez, 2009
Family Mormoopidae		
Mormoops megalophylla Peters, 1864	*Anenterotrema auritum*	Ramírez, 2015
	Ochoterenatrema labda	Peralta, 2012
	Paralecithodendrium scabrum	Ramírez, 2015
	Limatulum diminutum	Ramírez, 2015
	Limatulum gastroides	Peralta, 2012
	Limatulum limatulum	Ramírez, 2015
	Limatulum oklahomense	Ramírez, 2015
	Maxbraunium tubiporum	Ramírez, 2015
	Parabascus yucatanensis	Peralta, 2012
	Urotrema scabridum	Ramírez, 2015
	Vampirolepis decipiens	Peralta, 2012
	Vampirolepis elongatus	Ramírez, 2015
	Vampirolepis gertschi	Peralta, 2012
	Allintoshius tadaridae	Ramírez, 2015
	Aonchoteca speciose; *Linustrongylus pteronoti*	Peralta, 2012; Ramírez, 2015
	Macuahuitloides inexpectans	Jiménez et al., 2013
	Tricholeiperia carnegiensis	Ramírez, 2015
	Pterothominx sp.	Ramírez, 2015
	Litomosoides guiterasi	Ramírez, 2015
	Physaloptera sp.	Ramírez, 2015
	Spirura mexicana	Peralta et al., 2012
	Acuariidae gen. sp. (as a larva)	Peralta, 2012
	Nematoda gen. sp. (as a larva)	Ramírez, 2015

Table 3 (continued). Checklist of species of parasites recorded per bat species in Mexico and Central America

Bat Species	Helminth Species	References
Pteronotus davyi Gray, 1838	*Ochoterenatrema labda*	Clarke, 2008
	Limatulum diminutum	Peralta, 2012
	Limatulum gastroides	Peralta, 2012
	Limatulum limatulum	García, 1995
	Limatulum oklahomense	Peralta, 2012
	Urotrema scabridum	Peralta, 2012
	Vampirolepis elongatus	García, 1995
	Linustrongylus pteronoti	García, 1995
	Websternema parnelli	García, 1965
	Pterothominx sp.	García, 1995
	Litomosoides guiterasi (as a larva)	Peralta, 2012
	Physocephalus sexalatus (as a larva); Nematoda gen. sp. (as a larva)	Juárez, 2015; Peralta, 2012
Pteronotus parnellii Miller, 1902	*Limatulum diminutum*	Peralta, 2009
	Limatulum gastroides	García, 1995
	Limatulum limatulum	Peralta, 2009
	Limatulum oklahomense	Peralta, 2009
	Plagiorchis muris	Peralta, 2009
	Urotrema scabridum	Peralta, 2009
	Vampirolepis decipiens	Peralta, 2009
	Vampirolepis gertschi	Peralta, 2012
	Linustrongylus pteronoti	Peralta, 2009
	Websternema parnelli	Garcia, 1995
	Pterothominx sp.	Peralta, 2009
	Litomosoides guiterasi	Peralta, 2009
	Litomosoides guiterasi (as a larva)	Peralta, 2009
	Spirura mexicana	Peralta, 2009
	Physocephalus sexalatus (as a larva)	Peralta, 2009
	Acuariidae gen. sp. (as a larva)	Peralta, 2009
Pteronotus personatus (Wagner, 1843)	*Limatulum diminutum*	Peralta, 2012
	Limatulum gastroides	Peralta, 2012
	Maxbraunium tubiporum	Peralta, 2012
	Urotrema scabridum	Peralta, 2012
Family Natalidae		
Natalus mexicanus Miller, 1902	*Anenterotrema auritum*	Stunkard, 1938
	Ochoterenatrema labda	Lunaschi and Drago, 2011
	Paralecithodendrium emodillum	Caballero, 1943b
	Limatulum limatulum	Caballero, 1943b
	Limatulum oklahomense	Caballero and Bravo Hollis, 1950
	Parabascus yucatanensis	Stunkard, 1938
	Plagiorchis muris	Caballero, 1943
	Urotrema scabridum	Caballero, 1942
	Vampirolepis decipiens	Peralta, 2012
	Allintoshius tadaridae	Caballero, 1942
	Tricholeiperia carnegiensis	Chitwood, 1938
	Tricholeiperia pearsei	Chitwood, 1938
	Aonchotheca speciosa	
	Seuratum cancellatum	Chitwood, 1938

Table 3 (continued). Checklist of species of parasites recorded per bat species in Mexico and Central America

Bat Species	Helminth Species	References
Family Phyllostomidae		
Artibeus aztecus (Andersen, 1906)	*Vampirolepis elongatus*	Peralta, 2012
	Aonchotheca speciosa	Peralta, 2012
	Litomosoides guiterasi (as a larva)	Peralta, 2012
Artibeus phaeotis (Miller, 1902)	*Vampirolepis artibei*	García, 1986
	Cheiropteronema globocephala	Chitwood 1938
Artibeus jamaicensis Leach, 1821	*Vampirolepis elongatus*	García, 1995
	Bidigiticauda vivipara	Chitwood 1938
	Cheiropteronema globocephala	Chitwood, 1938
	Parahistiostrongylus octacanthus	Ubelaker et al., 1979
	Litomosoides chitwoodi	Bain et al., 2003
	Litomosoides sp.	García, 1995
Artibeus lituratus (Olfers, 1928)	*Bidigiticauda vivipara*	Caballero-Deloya 1971
	Cheiropteronema globocephala	Ubelaker et al., 1979
Artibeus toltecus (Saussure, 1860)	*Cheiropteronema globocephala*	Ubelaker et al., 1979
	Litomosoides brasiliensis	Bain et al, 2003
Carollia perspicillata (L. 1758)	*Cheiropteronema globocephala*	Ubelaker et al., 1979
	Litomosoides brasiliensis	Bain et al, 2003
	Litomosoides penai	Jiménez-Quirós and Arroyo-Sancho, 1960
Desmodus rotundus Geoffroy, 1810	*Biacantha desmoda*	García, 1995
	Capillaria sp.	Peralta, 2012
Glossophaga soricina Pallas, 1766	*Anenterotrema auritum*	Lunaschi and Drago, 2011
	Litomosoides hamletti; *Vampirolepis elongatus*	Chitwood, 1938; Ubelaker et al., 1979
Leptonycteris yerbabuenae Martínez and Villa, 1940	*Anenterotrema auritum*	Juárez-González, pers. comm.
	Vampirolepis elongatus	Peralta, 2012
	Aonchotheca speciosa	Juárez-González, pers. comm.
	Litomosoides guiterasi	Peralta, 2012
	Litomosoides guiterasi (as a larva)	Peralta, 2012
Macrotus waterhousii Gray, 1843	*Limatulum aberrans*	Caballero and Bravo, 1950
	Litomosoides leonilavazquezae	Caballero, 1939
	Vampirolepis gertschi	Galindo, 2014; Ramírez, 2015
	Torrestrongylus tetradorsalis	Caspeta-Mandujano et al., 2015
	Aonchotheca speciosa	Peralta, 2012
	Spirura mexicana	Peralta et al., 2012
	Litomosoides guiterasi	Galindo, 2014
Micronycteris hirsuta	*Anenterotrema freitasi*	Caballero, 1964
	Limatulum isthmicus	Caballero, 1964
	Castroia silvai	Caballero and Montero-Gei, 1963
	Maxbraunium tubiporum	Caballero, 1964
Micronycteris microtis	*Anenterotrema auritum*	Stunkard, 1938
	Capillaria sp.	Chitwood, 1938
Phyllostomus discolor (Wagner, 1843)	*Histiostrongylus coronatus*	Ubelaker et al., 1979
	Histiostrongylus spinosus	Vaucher and Durette-Desset, 1999
Phyllostomus hastatus (Pallas, 1767)	*Anenterotrema stunkardi*	Caballero and Groccott, 1960
	Histiostrongylus coronatus	Ubelaker et al., 1979
	Parahistiostrongylus octacanthus	Ubelaker et al., 1979
Trachops cirrhosus Spix, 1823	*Tricholeiperia leiperi*	Chitwood, 1938

Table 3 (continued). Checklist of species of parasites recorded per bat species in Mexico and Central America

Bat Species	Helminth Species	References
Family Vespertilionidae		
Lasiurus blossevillii (as *Vespertilio lasiurus*)	*Maxbraunium tubiporum*	Caballero and Cerecero, 1942
Lasiurus cinereus Beauvois, 1796	*Paralecithodendrium macnabi*	Caballero and Zerecero, 1951
	Paralecithodendrium scabrum	Galindo, 2014; Ramírez, 2015
Eptesicus sp.	*Prosthodendrium cordiforme*	Caballero and Brenes-Madrigal, 1957
	Limatulum costarricensis	Caballero and Brenes-Madrigal, 1957
	Urotrema scabridum	Caballero et al., 1957
Myotis velifer Allen, 1890	*Anchitrema sanguineum*	Ramírez, 2015
	Ochoterenatrema labda	Ramírez, 2015
	Paralecithodendrium scabrum	Ramírez, 2015
	Limatulum limatulum	Ramírez, 2015
	Tremajoannes buckleyi	Ramírez, 2015
	Plagiorchis vespertilionis	Ramírez, 2015
	Urotrema scabridum	Ramírez, 2015
	Vampirolepis decipiens	Ramírez, 2015
	Allintoshius tadaridae	Ramírez, 2015
	Trichuroides myoti	Ramírez, 2015
	Acuariidae gen. sp. (as a larva)	Ramírez, 2015
Pipistrellus hesperus Allen, 1864	*Plagiorchis micracanthos*	Heddergott and Steinbach, 2015

Table 4. Records in Mexico listing species of helminths with no confirmed host identification and not considered in this checklist

Helminth	Host	State	Site of Infection	References
Nematoda				
Capillaridae	None provided	Sinaloa	—	Espericueta, 2012
Rhabditida (?)	None provided	Sinaloa	—	Espericueta, 2012
Biacantha sp.	*Desmodus rotundus*	Colima	Intestine	García-Márquez, 1985
Capillaria sp.	*Micronycteris megalotis mexicana*	Yucatán	Stomach	Chitwood, 1938
Litomosoides sp.	*Artibeus jamaicensis*, *A. intermedius*	Jalisco	Mesentery	García, 1995
Pterothomix sp.	*Pteronotus davyi*	Jalisco	Intestine	García, 1995
Vampirolepis sp.	*Tadarida brasiliensis*	Nuevo León, Puebla, Zacatecas	Intestine	Guzmán-Cornejo et al., 2003
Vexillata sp.	*Artibeus jamaicensis*	Morelos	Intestine	Eslava, 2005

Table 5. Distribution of parasites in the bat species surveyed for helminthes up to 2015

Species of parasite	Species of bat																												
	Balantiopteryx plicata	*Tadarida brasiliensis*	*Mormoops*	*Pteronotus davyi*	*Pteronotus parnellii*	*Pteronotus personatus*	*Natalus mexicanus*	*Dermanura azteca*	*Dermanura phaeotis*	*Artibeus jamaicensis*	*Artibeus lituratus*	*Dermanura tolteca*	*Carollia perspicillata*	*Desmodus rotundus*	*Glossophaga soricina*	*Leptonycteris*	*Macrotus waterhousii*	*Micronycteris hirsuta*	*Micronycteris microtis*	*Phyllostomus discolor*	*Phyllostomus hastatus*	*Trachops cirrhosus*	*Lasiurus blossevillii*	*Lasiurus cinereus*	*Eptesicus* sp.	*Myotis velifer*	*Parastrellus hesperus*
Anchitrema sanguineum																										X	
Anenterotrema auritum			X				X								X	X			X								
Anenterotrema freitasi																		X									
Anenterotrema stunkardi																					X						
Dicrocoelium rileyi		X																									
Platynosum beltrani		X																									
Castroia silvai																		X									
Ochoterenatrema labda	X	X	X	X			X																			X	
Paralecithodendrium emodillum							X																				
Paralecithodendrium macnabi																							X				
Paralecithodendrium scabrum			X																				X			X	
Prosthodendrium cordiforme																								X			
Limatulum aberrans																	X										
Limatulum costarricensis																								X			
Limatulum diminutum			X	X	X	X																					
Limatulum gastroides	X		X	X	X	X																					
Limatulum isthmicus																		X									
Limatulum limatulum		X	X	X	X		X																			X	
Limatulum oklahomense			X	X	X		X																				
Maxbraunium tubiporum			X			X																	X				
Parabascus yucatanensis			X				X																				
Tremajoannes buckleyi																										X	
Plagiorchis micracanthos																											X
Plagiorchis muris					X		X																				
Plagiorchis vespertilionis		X																								X	
Urotrema scabridum	X	X	X	X	X	X	X																		X	X	
Vampirolepis artibei									X																		
Vampirolepis decipiens	X	X	X		X		X																			X	
Vampirolepis elongatus	X		X	X				X		X					X	X											
Vampirolepis gertschi			X		X												X										
Allintoshius tadaridae		X	X				X																			X	
Biacantha desmoda														X													
Bidigiticauda vivipara										X	X																
Cheiropteronema globocephala									X	X	X	X	X														
Histiostrongylus coronatus																				X	X						
Histiostrongylus spinosus																				X							
Linustrongylus pteronoti			X	X	X										X												
Macuahuitloides inexpectans			X																								
Parahistiostrongylus octacanthus										X											X						
Tadaridanema delicatus		X																									
Torrestrongylus tetradorsalis																	X										
Tricholeiperia carnegiensis			X				X																				
Tricholeiperia leiperi																						X					
Tricholeiperia pearsei							X																				
Websternema parnelli				X	X																						
Aonchotheca martinezi							X																				
Aonchotheca speciosa							X	X							X	X	X										
Capillaria palmata		X																									
Capillaria sp.														X					X								
Pterothominx sp.			X	X	X																						
Trichuroides myoti	X																									X	
Litomosoides brasiliensis												X	X														
Litomosoides chitwoodi										X																	
Litomosoides fosteri															X												
Litomosoides guiterasi			X		X			X							X	X	X										
Litomosoides hamletti															X												
Litomosoides leonilavazquezae																	X										
Litomosoides penai													X														
Litomosoides sp.										X																	
Physaloptera sp. (as a larva)			X																								
Spirura mexicana			X	X	X	X											X										
Spirocercidae																											
Physocephalus sexalatus (as a larva)	X			X	X										X				X								
Pterygodermatites (*Pterygodermatites*) *mexicana*	X																										
Rictularia nana	X																										
Seuratum cancellatum							X																				
Acuariidae gen. sp. (as a larva)	X	X	X		X																						
Nematoda gen. sp. (as a larva)	X	X	X																								

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